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## **Evaluation of perennial cereal rye longevity and forage production when harvested at different stages of maturities and under grazing.**

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### **Summary**

Perennial Cereal Rye (PC rye) (*Secale cereale*) has been promoted as a highly productive perennial forage crop for hay/silage and grazing for dryland areas. However, earlier research done at Agriculture and Agri-Food Canada – Semiarid Prairie Agricultural Research Centre (AAFC-SPARC) have found that time of seeding and defoliation on PC rye can greatly affect the number of plants surviving through the winter. Current research at AAFC-SPARC indicated that the stage of harvest (preboot, boot and flowering) does affect stand survival and that PC rye longevity is lower ( $P<0.001$ ) than other short lived forage species, such as, Dahurian wildrye and Slender wheatgrass under irrigation or dryland. Grazing studies at AAFC-SPARC also observed PC rye plant counts decline by over 48% after two years of moderate grazing at the boot to heading plant stage.

### **Introduction**

Perennial cereal (PC) rye is a new forage crop in western Canada that was developed at the Lethbridge Research Centre and is a crossing between cultivated rye (*Secale cereale* L.) and a wild perennial ryegrass (*S. montanum* Guss.). Perennial cereal rye is a three-to-four year perennial cereal crop that has the potential to provide high yields of forage for hay and grazing. A major benefit of PC rye is the ability to eliminate many of the establishment and seeding costs associated with traditional annual crops which would help reduce soil erosion and contribute to improved soil structure and organic matter content. However, successful use of PC rye depends on its establishment, over wintering and stand longevity, under both haying and grazing conditions. An earlier study at Swift Current (Lennox et al. 2003) reported that winter hardiness is a major limitation to growing PC rye in southwest Saskatchewan, especially when sufficient snow cover is not available. Although PC rye compared favourable to other winter cereals for hardiness the time of seeding is critical with seeding during mid-to-late August providing the best winter hardiness attributes. The study also reported that time of defoliation can affect the number of plants surviving the winter, particularly if the PC rye is seeded in late spring early summer. Clearly further research is needed to determine how best to use and harvest PC rye as forage in the semiarid prairie area.

### **Materials and Methods**

The research was conducted at the Agriculture and Agri-Food Canada - Semiarid Prairie Agricultural Research Centre (AAFC-SPARC) near Swift Current, Saskatchewan and consisted of two studies. The first study was evaluating how PC rye (PCR) (cv. ACE-1) forage production compared to two other short lived grass species, Dahurian

wildrye (DWR) (cv. Arthur) and slender wheatgrass (SWG) (cv. Revenue) over time. The experiment was a split plot design with six replicates. The main plot was three harvest stages (preboot, boot, flowering + 2 weeks) and the sub plot was three species (DWR, SWG, and PCR) for a total of 54 plots. Seeding occurred in 2001, with one site on an irrigated clay loam, and the other site on a dryland sandy loam. Agronomic and forage harvesting practices for the short lived grass species vs. PCR forage comparison are shown in Table 1.

**Table 1.** Agronomic and forage operations for the short lived grass species (DWR and SWG) vs. PCR forage comparison seeded during the 23-24<sup>th</sup> of May in 2001 and harvested in the 2002 and 2003 growing seasons<sup>1</sup>.

Operations	Dryland site	Irrigation site
Seeding rate	100 seeds per m row length (PLS)	100 seeds per m row length (PLS)
Plot size	9.14 m <sup>2</sup>	9.14 m <sup>2</sup>
Seeding operation	Seed drill with a double disk opener and seed depth at 2.0 cm	Seed drill with a double disk opener and seed depth at 2.0 cm
Fertilizer & herbicide	39 kg ha <sup>-1</sup> of 11-52-0 and 2,4-D amine twice during establishment.	39 kg ha <sup>-1</sup> of 11-52-0 and 2,4-D amine twice during establishment.
Irrigation	none	About 75 mm during the two production years
Three stages of harvest <sup>2</sup>	Pre-boot, boot & flowering+2wks	Pre-boot, boot & flowering+2wks
Precipitation – April 1 to last cutting date	2002 (285 mm) & 2003 (177 mm)	2002 (248 mm) & 2003 (177 mm)

<sup>1</sup> Dahurian wildrye =DWR; slender wheatgrass = SWG; and PC rye = PCR.

<sup>2</sup> Pre-boot (beginning of June); boot (end of June beginning of July) and flowering (end of July – Aug.).

The second study evaluated the impact of grazing on PCR that was seeded on Aug. 30<sup>th</sup>, 2004. This PCR pasture was associated with a previous Saskatchewan ADF research project (Iwaasa et al. 2005) evaluating the potential grazing performance of PCR to winter and spring seeded triticale annuals. In that study, successful establishment of PCR was difficult due to winter kill and drought conditions and in three of the five years the PCR did not survive. In 2004 the PCR was once again re-seeded into a pasture that was 3.25 ha (8 acres) in size and divided in half. Grazing of the PCR pastures occurred in 2005 and 2006 with yearling steers and/or cow/calf pairs (Fig. 1). Grazing of the PCR pastures occurred at the flag to boot stage and stocking rates in 2005 and 2006 were about 11 AU ha<sup>-1</sup> (4.4 AU ac<sup>-1</sup>) and 21 AU ha<sup>-1</sup> (8.4 AU ac<sup>-1</sup>), respectively. In 2005, moisture conditions were sufficient to get a second grazing of the regrowth in July. Only in 2005 were animal performances [average daily gains (ADG), grazing days per ha] and average plant (m<sup>2</sup>) counts recorded, while in 2006 only plant counts were collected. In 2005 cattle entering and coming off the PCR pastures were weighted after a 12 hour fast and a pencil shrink of 5% was used when cattle were grazing the regrowth.

Forage and pasture yields were determined for both studies at different stages of harvested. All samples were collected and dried at 60°C for 48 h and ground through a 1 mm screen. The following forage analyses were done: *In vitro* organic matter digestibility

(IVOMD), crude protein (CP), acid detergent fibre (ADF), neutral detergent fibre (NDF) and certain minerals (Ca and P) were determined for each sample using Standard Operating Procedures Forage Laboratory (2001). Where possible the treatment effects were analyzed individually by SAS software. Analysis of variance (Proc GLM) was calculated for biomass yields and forage qualities for two growing seasons (2002, 2003). When treatments effect was significant at  $P=0.05$ , a LSD value was calculated from the error mean square for mean separation testing.



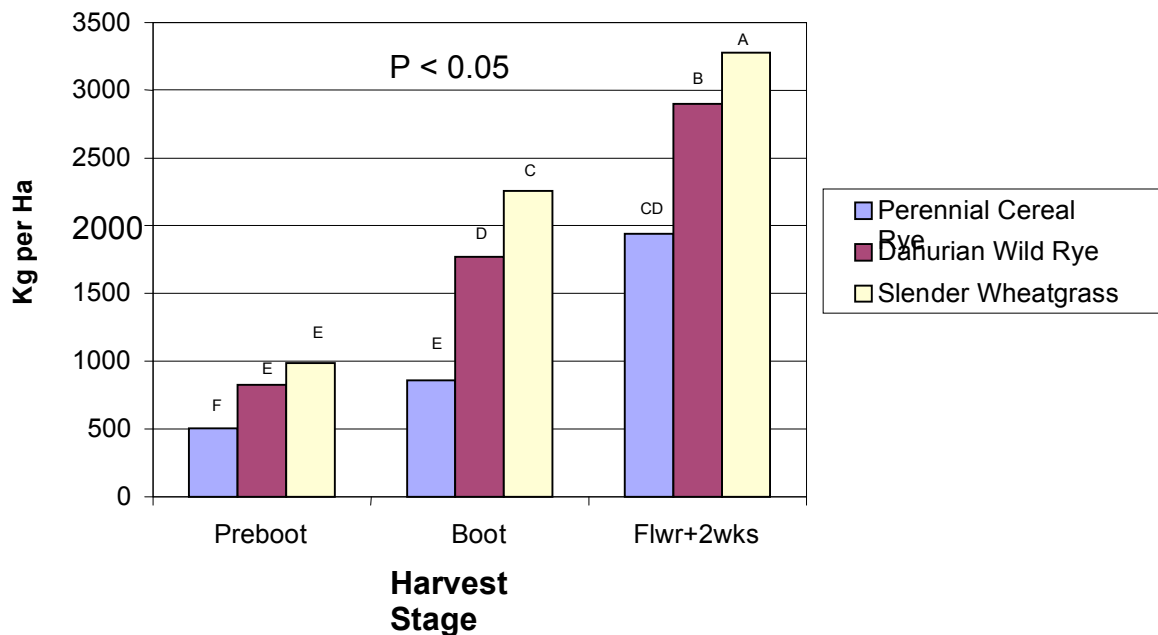
**Figure. 1.** Yearling steers grazing perennial cereal rye that is in its second year of production (stock rate 8.4 AU per acre).

## Results and Discussions

Forage qualities of the PCR were around 16-18% crude protein and 60% organic matter digestibility which is adequate to meet the nutritional needs of growing yearling steers and calves was observed. In 2005 and 2006, the average available forage DM yields were  $3465 \text{ kg ha}^{-1}$  ( $3094 \text{ lb ac}^{-1}$ ) and  $1441 \text{ kg ha}^{-1}$  ( $1286 \text{ lb ac}^{-1}$ ), respectively. Forage productions and qualities were similar to those reported previously (Iwaasa et al. 2005). Forage production dropped in the second production year and this was due to substantial decline in PCR plant survival. Spring plant counts ( $\text{m}^2$ ) taken from the large pastures in 2005 to 2006 declined by 48% which would account for the reduced forage production observed in 2006. These results are in agreement with the small plot studies which also observed substantial decline in PCR plant survival by the 2<sup>nd</sup> production year. Observed grazing performances were  $0.88 \text{ kg d}^{-1}$  ( $1.95 \text{ lbs d}^{-1}$ ) and about 154 grazing days  $\text{ha}^{-1}$  ( $63 \text{ grazing day ac}^{-1}$ ) and these results were similar to those reported previously (Iwaasa et al. 2005). Although good cattle performances can be observed with grazing PCR, the PCR stand was not very grazing tolerant, especially when grazed at the tiller to boot stage and this has been observed by others (Thomas 2002).

Results from the small plot study found that average DM forage yields on dryland for PCR harvested at three different stages (e.g., preboot, boot and flowering) were significantly lower ( $P<0.05$ ) than production from two other short lived grass species

(Fig. 2). Similar results were also observed for the PCR vs the two other short lived grass species under irrigation (data not presented). The PCR forage production declines



**Figure 2.** Mean forage DM yields (kg ha) for three different stages of maturity (preboot, boot and flowering) over the 2002-2003 crop year for three short lived grasses (perennial cereal rye, Dahurian wild rye and slender wheatgrass) on a dry land site.

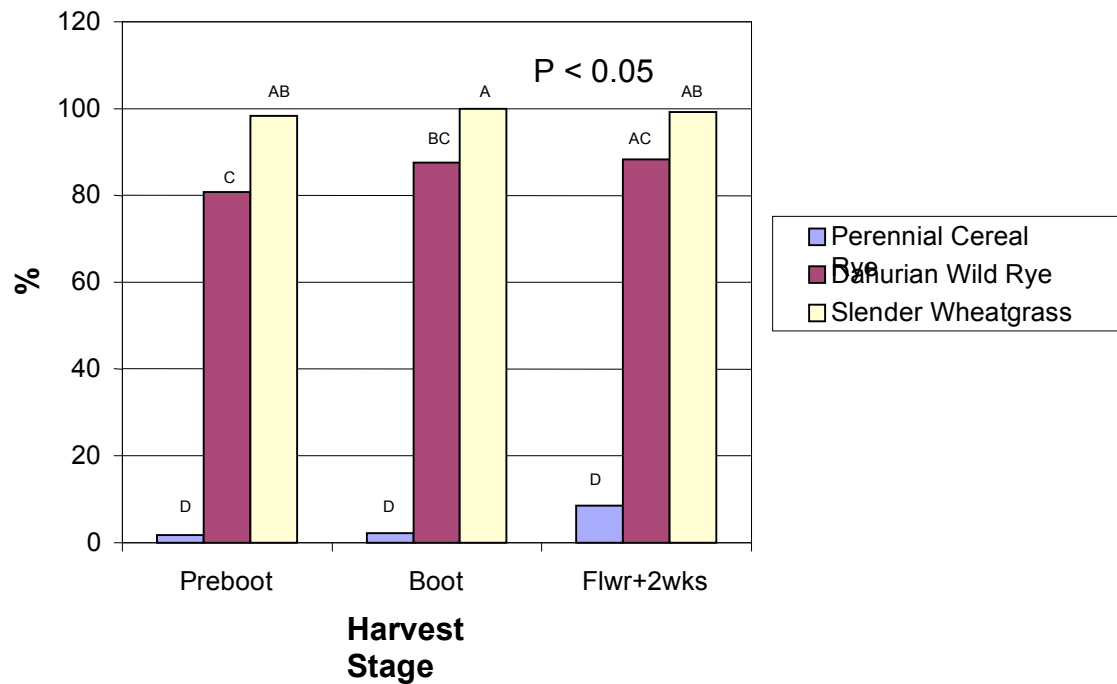
for the small plot studies were more severe than were observed in the large pasture study and this may have been due to the very dry spring of 2002 and hot and dry summer of 2003.

Percent stand decline from 2002 compared to 2004 was over 80% less ( $P < 0.05$ ) for dryland PCR compared to the other two short lived species at all three growth stages (Fig. 3.) Poor PCR stand survival was also observed on the irrigation plots where there was over 70% decline in the PCR after two production years compared to the other short lived grasses (data not presented). PCR plant survival did not differ ( $P = 0.34$ ) among different plant stages whether the plant was cut at preboot, boot or flowering stages for PCR growing on irrigation or dryland. These results are not encouraging for the potential use of PCR either for grazing or for hay production in southwest Saskatchewan.

## Conclusions

Although, PCR has been reported to survive up to four years, results from this study has revealed that PCR can be quite short lived and not as productive as other recognized short lived grass species. In addition, the ability of PCR to provide a productive grazing and hay forage for more than two years is questionable. Further

research is needed to develop a better grazing tolerant and longer lived PCR plant material before it can be recommended for southern Saskatchewan growing areas.



**Figure 3.** Mean percent plot stand for three different stages of maturity (preboot, boot and flowering) over two production years (2002 and 2003) for three short lived grasses (perennial cereal rye, Dahurian wild rye and slender wheatgrass) on a dry land site

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